

Reasons for choosing air-to-air heat pumps on Eigg

Introduction

Concerns have been raised whether air-to-air heat pumps is a viable solution for the Isle of Eigg. The specific concerns are;

- 1) The risk of moisture condensing somewhere undesirable in old damp houses.
- 2) Air-to-air heat pumps being inefficient because of the leakiness of poorly insulated houses.
- 3) Questions have also been raised about the pricing of the air-to-air heat pumps used in the cost analysis.

The use of heat pumps in Scandinavia

Air-to-air heat pumps are very common in the Scandinavian countries. Therefore, most of the data used to investigate their applicability on Eigg is from Norwegian studies. In a study from Norway it was found that 25% of Norwegian households had a heat pump installed, with 88% of the heat pumps being air-to-air. (Larsen, 2013) They have been used all over Norway for the last 20 years with satisfying results, especially in the regions with milder climate, like the South-West coast. (Bøeng, 2014) There is however some research indicating that the added savings from heat pumps are reduced because households keep a higher indoor air temperature when a heat pump is installed. (Gram-Hanssen, Christensen, & Petersen, 2012)

The map (Figure 1) shows the location of Mallaig, which is the closest location to Eigg with weather data available, and the town Stavanger in Norway. As we will see, the climate is very similar between these two places, and because the use of air-to-air heat pumps is widespread in Stavanger, it was used for comparison.



Figure 1 Location of Stavanger and Mallaig

Temperature

Figure 2 shows the average temperature over the last 5 years between Stavanger and Eigg (Mallaig). The average temperature over the last five years are almost indistinguishable. With closer examination, it can be observed that the highest and lowest peak are slightly higher for Stavanger than Eigg (Mallaig). This small difference is probably more of a benefit; as low temperatures are a problem for air-to-air heat pumps. As a result, the more stable temperature on Eigg is likely to be beneficial for the heat humps. Comparing the temperature between the two places, it is clear that temperature is no concern.

Temperature, Stavanger vs Mallaig



Figure 2 Temperature, Stavanger vs Mallaig

1) Moisture Concern

Another concern of installing air-to-air heat pumps in Scotland is the high humidity levels. Going back to the weather data comparison, it is again clear that the two places have a very similar humidity profile (Figure 3). At certain times the humidity of Eigg (Mallaig) is 5-10% higher than in Stavanger. But most of the time, especially over the last two years the humidity levels have been similar.

Humidity, Stavanger vs Mallaig

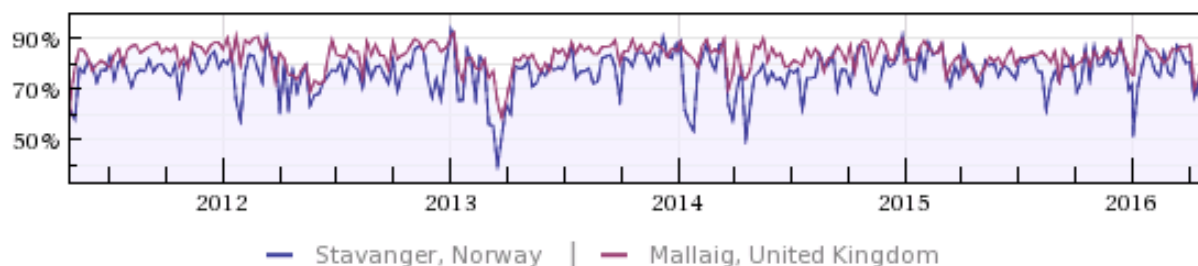


Figure 3 Humidity, Stavanger vs Mallaig

In broader terms, no research was found about the added problem of moisture with air-to-air heat pumps, compared to other means of delivering heat.

2) Inefficiency because of poorly insulated houses

The second issue is related to the air-to-air heat pumps efficiency in old poorly insulated houses. Firstly, part of the solution on Eigg is to upgrade all the oldest houses to at least 1995 standards of insulation. This should assure that none of the houses are so leaky that all the hot air escapes. Secondly there are studies where air to air heat pumps have been installed in old poorly insulated houses. The effect was seen to drop in the oldest houses (+50years), but the savings was still more than 20% compared to electric resistance heating. (Sintef, 2004) Installing the inside unit at a low level in the house so that the air can travel up through the building will ensure good distribution of heat.

3) Pricing of air-to-air heat pumps

The cost of air-to-air heat pumps is low compared to water or ground source heat pumps. It is possible to get air-to-air heat pumps as cheap as 500£, but it is generally considered that a quality air-to-air heat pump will cost 1,500-2,000£. (Enova, 2016) This is lower than the cost of 2,500£, which was used in the cost analysis for Eigg. The reason a higher price was chosen is because some of the largest houses would need two heat pumps. It is also very likely that some of the heat pumps would have to be maintained or replaced during their lifetime.

A standard installation cost is typically 500£. (Mitsubishi Electric, 2016) However the cost for installation on Eigg was estimated to be twice of that, 1,000£. This is partly because of the distance from any city centre. The workers would therefore have to commute and stay overnight, making the installation more expensive. Secondly, some of the larger houses would have to install two heat pumps, and because the "Total cost of heat pumps" is a simple averaging exercise, this had to be reflected in the final figure.

Conclusion

Comparing weather data between Stavanger and Eigg (Mallaig), it is highly unlikely that moisture will lead to more problems in Scotland than in Norway. Also, no literature was found with regards to the added problem of moisture with air-to-air heat pumps, compared to other heat distribution systems.

Houses on Eigg will after building upgrades have insulation of minimum 1995 levels, which should avoid the problem of hot air escaping. Also, research shows that even poorly insulated houses will have some added benefit of installing air-to-air heat pumps, compared to other means of heating.

The pricing of 3,500£ per house, might seem high at first, but includes some important aspects. It incorporates that some houses will need more than one heat pump, higher installation cost in remote areas, and maintenance over the heat pumps lifetime.

References

- Bøeng, A. C. (2014, July 14). *Energibruk i husholdningene, 2012*. Retrieved from SSB:
<https://www.ssb.no/energi-og-industri/statistikker/husenergi/hvert-3-aar/2014-07-14>
- Enova. (2016, April 26). *Luft/luft-varmepumpe*. Retrieved from enova.no:
<http://www.enova.no/radgivning/privat/rad-om-produkter-og-losninger/oppvarmingsalternativ/luftluft-varmepumpe-/luftluft-varmepumpe/112/275/>
- Gram-Hanssen, Christensen, & Petersen. (2012). Air-to-air heat pumps in real-life use: Are potential savings achieved or are they transformed into increased comfort? *Energy and Buildings*, 64-73.
- Larsen, B. H. (2013). *Hvem eier varmepumpe og hva gjør det med*. Oslo: SSB.
- Mitsubishi Electric. (2016, April 26). *STANDARD MONTERING*. Retrieved from Mitsubishi Electric:
<http://www.miba.no/standard-montering/>
- Sintef. (2004). *Fiin gammel aargang*. Trondheim: Sintef -Arkitektur og byggteknikk.